Portable Direct Methanol Fuel Cell Power Supply/Battery Charger

Cecelia Cropley

Giner Electrochemical Systems, LLC

Newton, MA

2003 Tri-Service Power Expo

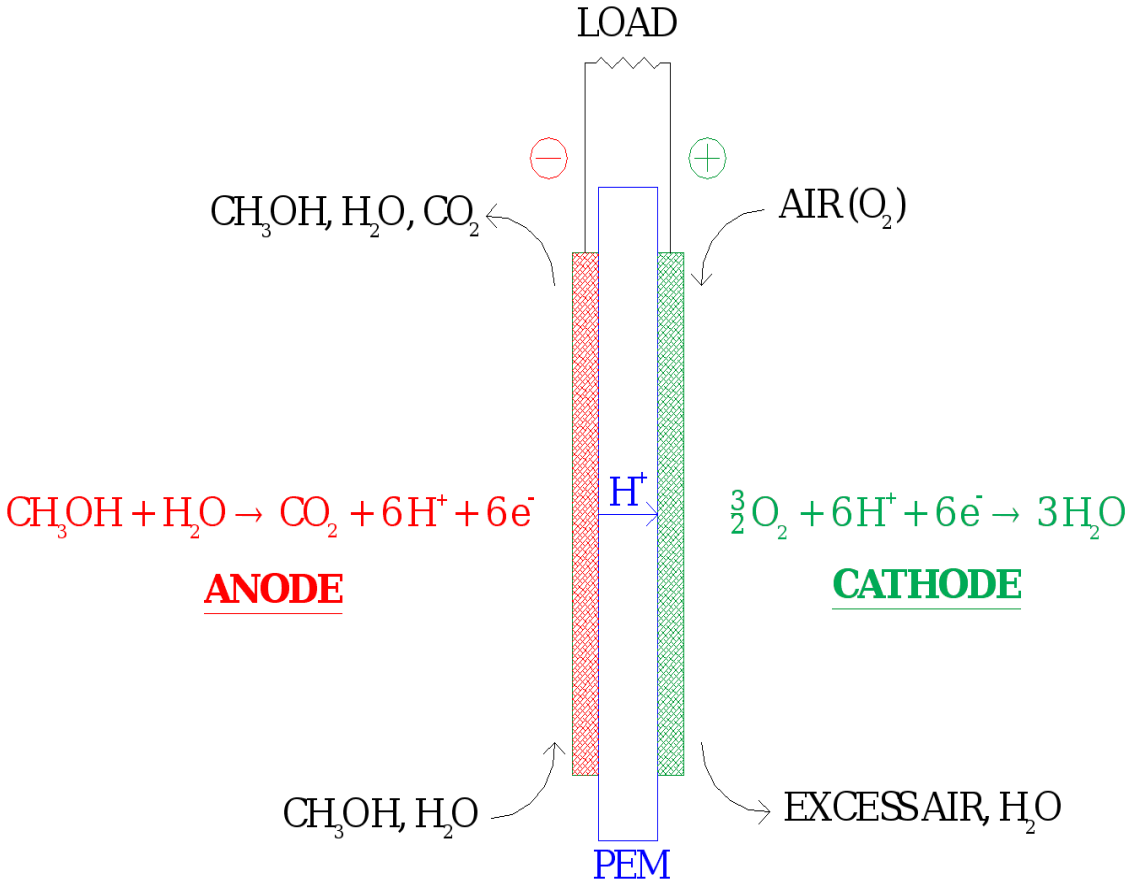
Norfolk, VA

July 15, 2003

Outline

- Introduction to DMFCs
- Military Applications
- GES DMFC Power Supply/Battery Charger
- Conclusions/Summary

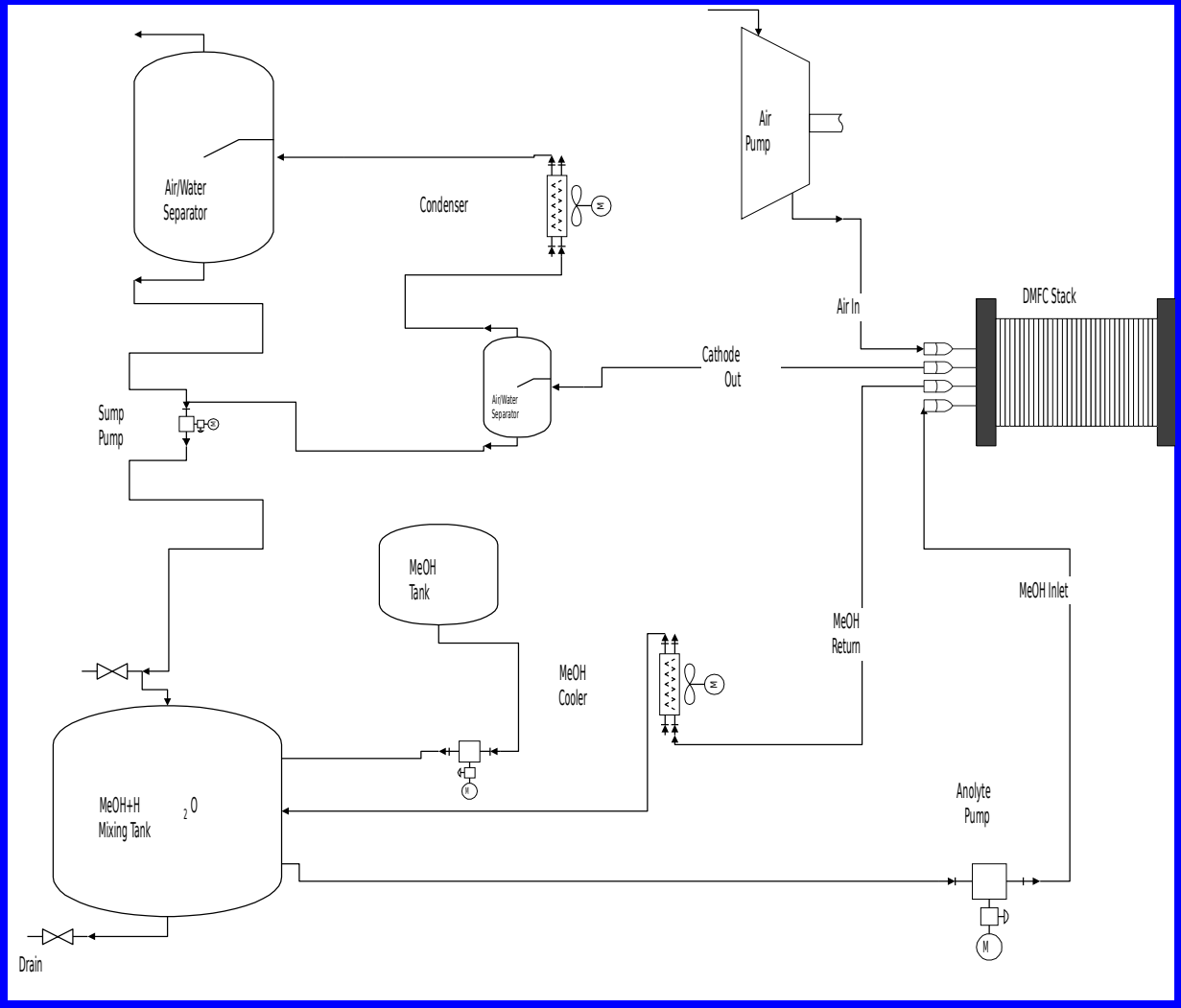
DMFC OPERATIONAL SCHEMATIC



GES Approach to DMFCs

Focus on Portable DMFC in 150W to 5+ kW Range

- Bipolar stack, operating at high power density
  - Minimizes stack weight, volume and cost
  - Minor efficiency penalty compared to low power density
- Use neat methanol fuel, on-board dilution
  - 0.5M to 1M
- Operate at 60-70°C
- Air at near-atmospheric pressure supplied by a blower



Schematic of a Direct Methanol Fuel Cell System

Military DMFC Applications

- Direct replacement of batteries as power sources for electronic devices – 20 W
- Portable battery charger for secondary batteries
  - 150 to 500 W
  - Manpackable or carried on “MULE”
- Replacement for small portable diesel generators
  - 2 to 5 kW

COMPARISON of DMFC WITH H_2/AIR PEMFC

Advantages of Methanol Fuel

- Methanol has much higher energy density than H_2 stored in cylinders or in hydrides
  - results in lower system weight and volume
- Methanol is much safer and easier to transport and handle than pressurized H_2 cylinders
  - refilling with methanol is easy

Advantages of Direct Methanol Technology

- Longer membrane lifetime due to operating in aqueous environment
- Reactant humidification is not required

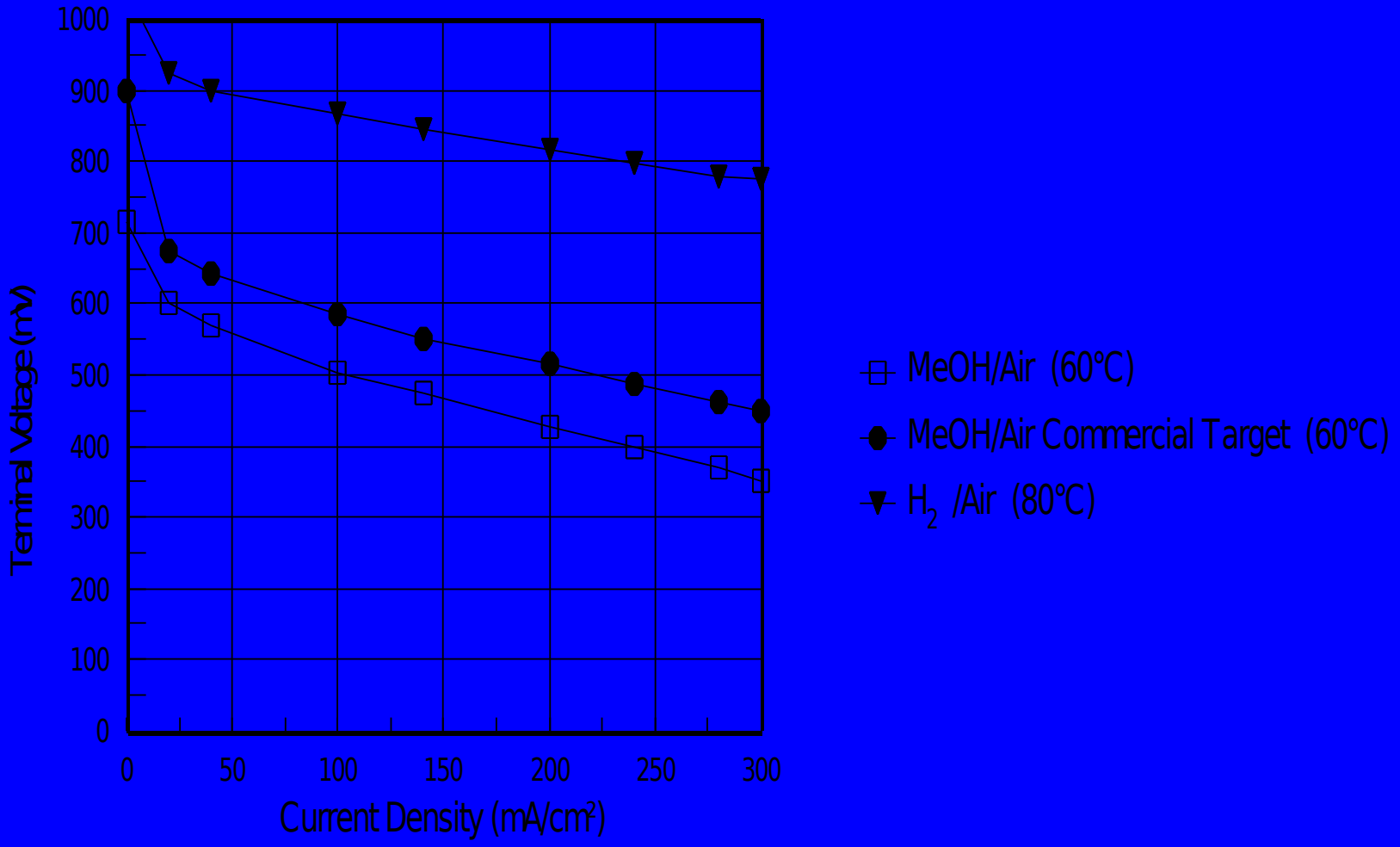
Compared to H_2 Systems with Methanol Reformer

- Low operating temperature of DMFC results in low thermal signature
- DMFC system has faster start-up and load following
- DMFC system is simpler and has lower weight and volume

Disadvantages of DMFC

- Operates at lower cell voltage and lower current density
- DMFC fuel efficiency is lower
  - Approx. 17% at present
  - With development, predict increase to 25%

Fuel Cell Performance Comparison



Fuel Comparison
1500-Whr Operation (includes tank)

	Methanol (neat)	**Hydrogen 2000 psig cylinder**	**Metal Hydride Canister**
Volume	1.5 liters	8.8 liters	4.5 liters
Weight	1.25 kg	13.2 kg (H_2 wt = 0.08 kg)	6.8 kg
Approx. Cost To Consumer	$0.40	H_2= $0.40 Filled tank=$20	H_2= $0.40 Filled tank=$20
Refillable by Customer?	YES	NO	NO

Status of DMFC Technology

- Large number of companies working on DMFC technology for consumer applications
- Commercialization of DMFCs for cell phones and laptops expected within 2-3 years
- Cost of DMFCs is coming down, and becoming competitive with Li batteries

Status of DMFC Power Supplies/Battery Chargers at GES

- Recently developed 3rd generation DMFC battery charger
  - 150 W
- Technology is readily scaleable down to 50 W and up to 5+ kW
- GES is planning to form a new company to commercialize the technology
  - Accepting orders for pre-production units

GES DMFC Portable Power Supply/Battery Charger

- 150 W AC/DC power output
- 15 pounds
- 10-liter volume
- Methanol storage for 2 hours operation
- Rapid start-up; excellent load following

Product Status

- 150-W complete system
  - Demonstrated successfully
  - Accepting pre-production orders
- 800-W module
  - Project underway with Parker Hannifin and Vectrix for hybrid scooter
- 1.5-kW stack
  - Demonstrated and delivered to JPL in Aug 01

Projected Size of Commercial Units

	Weight (lbs)	Volume (L)
150 W	7	6
500 W	25	20
1 kW	40	35

Conclusions

- GES has developed a lightweight portable DMFC battery charger
- Methanol fuel has many advantages for portable applications
- DMFCs are nearing commercialization

ACKNOWLEDGEMENTS

- Financial Assistance
  - DARPA
  - California Air Resources Board
  - South Coast Air Quality Management District
  - Jet Propulsion Laboratory
  - Army Research Laboratory

- Contributors
  - Tony LaConti
  - Jack Kosek
  - Monjid Hamdan
  - Simon Stone